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Global Warming: A Titanic Problem

By Dr. Md. Zulfequar Ahmad Khan
Arba Minch University, Ethiopia

Introduction - Global warming is one of those areas of science that gets all sorts of people exited. Though a few ask for more and more evidence that global environmental change is taking place, most accept that human activities are causing changes quite unlike any. But what exactly is it. Is it natural? Why is it happing? And what is it doing? The planet we inhabit is blessed with some very special conditions that just happen to be perfectly suited to sustain life. Global warming is the increase of average world temperature as a result of what is known as the greenhouse effect. Certain gases in the atmosphere act like glass in a greenhouse, allowing sunlight through to heat the earth`s surface but trapping the heat as it radiate back to space. As the greenhouse gases build up in the atmosphere the earth gets hotter. Organization related to this have quickly realize this and since 1980 have seen a huge research effort to explain the probable effects on our environment. The research continues, as we try to discover what rates of change can be tolerated.

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I. Introduction

Global warming is one of those areas of science that gets all sorts of people exited. Though a few ask for more and more evidence that global environmental change is taking place, most accept that human activities are causing changes quite unlike any. But what exactly is it. Is it natural? Why is it happing? And what is it doing? The planet we inhabit is blessed with some very special conditions that just happen to be perfectly suited to sustain life. Global warming is the increase of average world temperature as a result of what is known as the greenhouse effect. Certain gases in the atmosphere act like glass in a greenhouse, allowing sunlight through to heat the earth`s surface but trapping the heat as it radiate back to space. As the greenhouse gases build up in the atmosphere the earth gets hotter. Organization related to this have quickly realize this and since 1980 have seen a huge research effort to explain the probable effects on our environment. The research continues, as we try to discover what rates of change can be tolerated.

II. The Greenhouse Effect

It seems obvious that the main cause of this is the sun and the heat it sends hurtling our way. But the irony is that the sun`s energy by itself is not sufficient to make the planet warm enough for us to live on. The reason the earth is at just the right temperatures for human and other species to develop and thrive is because of a miracle called the "greenhouse effect". It is this phenomenon that keeps temperatures on the earth surface averaging 15°C. Without it the temperature would be -20°c –a cold that humanity would never have been able to evolve. Like the other planets in our solar system, the energy that the sun constantly emits strike our world, warming the surface. Because of the presence of atmosphere having almost perfect composition that can surround our earth like a blanket and that is held in place by gravity, there is the sustainability of life. Venus, for instance, has a thick atmosphere (thicker than the earth), which is composed mostly of carbon dioxide. Combined with it`s closeness to the sun the carbon dioxide levels on Venus send temperatures soaring to 460°C.

On an average the energy of the sun`s radiation on the top of the earth`s atmosphere is 1355w/m^2 (the solar constant). The effect this has on the earth`s climate is called the solar forcing of the climate system. This varies from season to season and on a larger timescale. At the earth`s surface on a sunny day the incident energy would be about 1000w/m^2. The greenhouse can be considered as an additional forcing factor, as it prevents some radiation from escaping to space.

It is clear that the evolution of the earth`s atmosphere has been intimately linked with the development of life on earth. Today both biological and geochemical processes are involved in maintaining its composition, but one species, human, has now become so numerous that it is beginning to affect the composition of the atmosphere and shift it from its natural equilibrium. The greenhouse effect changes the way the sun impacts the earth. The greenhouse effect is due to the presence of greenhouse gases.

III. The Greenhouse Gases

Water vapour is one of the most important greenhouse gases but its role is a bit complicated one. When water vapour condenses into clouds it can either absorb long-wave radiation from the ground causing further warming or reflects radiation from the sun causing a cooling effect. Which of these predominates depends on the type of clouds and its height in the atmosphere. Absorption of radiation is a property of a wide range of gas molecules, including carbon dioxide, methane, chlorofluorocarbon, nitrous oxide and sulpher dioxide, but among them carbon dioxide is the most important. These are all long-lived greenhouse gasses.

One of the main greenhouse gases is carbon dioxide (CO_2), which contributes about 50% to the greenhouse effect. The primary source of the increase in carbon dioxide is use of fossil fuels, but land-use changes also make remarkable contribution to it. Since prehistoric times people have burnt wood and other plant remains to produce heat and light. As wood become scarce, the use of coal became increasingly important and ultimately oil and gas. The demand of energy increased sharply and this demand was largely met by the increased use of fossil fuels (coal, oil and gas) and ultimately releasing more and more greenhouse gases to the atmosphere, particularly carbon dioxide (CO_2). The burning of fossil fuels is not the only way in which CO_2 can be released into the atmosphere. It is also produced in large amounts as a consequence of land-use change. Before the industrial revolution the rise in the concentration of CO_2 can be

Author : Associate Professor, Department of Geography & Environmental Studies, Arba Minch University, Arba Minch, Ethiopia.
E-mail : zulfequarkhan2006@yahoo.co.in

largely ascribed to deforestation, and agricultural land-use. Till now 20% of the released CO_2 (carbon content only) has been contributed by land-use changes. Land-use changes can release CO_2 into the atmosphere by causing oxidation of carbon compounds in the vegetation or the soil. Due to deforestation, there is an increase in soil erosion, which exposes organic matter to rapid oxidation, which ultimately becomes the source of carbon dioxide.

The ability of gases such as carbon dioxide to trap heat that creates the so called greenhouse effect. Without it, the sun`s energy would just enter the planet, or bounce off it. In the case of Venus, there is clearly too much heat-trapping carbon dioxide to sustain life. On earth, though, this heat trapping gas makes up only a small amount of what is in the atmosphere 0.03% or so. The small levels of "greenhouse gases" in the earth atmosphere are enough to heat up the planet`s surface making for human to survive. But when the composition changes, it would influence our climate or weather. We all know how fast the weather can change.

Carbon dioxide (CO_2) is necessary for the growth/survival of plants. But deforestation is now out of control. For example in 1987 an area of the Amazon rain forest, the size of Britain was burned, adding 500 million tones of (CO_2) to the atmosphere. The recent fire in Indonesia (1997), with more than a million hectares of forest was burned. The lost of forest also means that there are fewer trees to absorb CO_2. However, deforestations cause less than half the yearly total of CO_2, the rest comes from the burning of coal, oil and other fossil fuels. As far as electricity is concerned that is created mainly from burning of coal and oil. Every time we switch on a light we are adding to the greenhouse effect. The average European is responsible for nearly 2.5 times as much atmospheric carbon as a Latin American. The concentration of carbon dioxide has increased 25% since the industrial revolution. Half of this rise has been in the last 30 years. It is expected to double within decades if it is not checked. As a feedback processes, about half the CO_2 released by burning fossil fuels is absorbed by the oceans. It is taken by minute sea creatures or dragged to the ocean depths by the circulation of water. Recent research suggests that as the earth heats up, the ocean will be less efficient in absorbing CO_2, living more in the atmosphere and so adding further to global warming. It is because, observations since 1961 show that the ocean has been absorbing more than 80% of heat added to the climate system, and that ocean temperatures have increased to depths of at least 3000m. That's why the efficiency of absorbing CO_2 by ocean has been decreasing. The other green house gases are methane (CH_4), chlorofluorocarbon (CFCs), nitrous oxide (N_2O) and sulpher dioxide (SO_2). It is observed that carbon dioxide, methane, and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values.

The concentration of methane in the atmosphere is rising at a fast rate. It is produced by anaerobic respiration in a wide variety of environment, such as the stomachs of animals, swamps, paddy fields, waterlogged soil, the release of natural gas from landfills and vegetation rotting in the absence of oxygen. A considerable amount is also produced during mining and oil/natural gas extraction. Methane is constantly removed from the atmosphere by reaction with hydroxyl (OH) radicals in the air and by the activity of soil organism. The problem with methane is that as the world population increases, agricultural activity must increase for the sake of sustainability and ultimately the emission of methane also increase. Since 1960 the amount of methane in the atmosphere has increased by 1% per year – twice as fast as the built-up of CO_2. A methane molecule is 30 times more effective in trapping the heat than CO_2 molecules. Methane molecules survive for 10 years in the atmosphere. As the world warms it causes feedback processes. The large quantities of methane stored in the frozen tundra of the north may be released. Methane trapped in the sea bed may also be freed by temperature rises. Increase in temperature cause the liberation of CO_2 and methane which ultimately cause further warming.

Nitrous oxide contributes about 6% to the greenhouse effect at the moment. It comes from both natural and man-made processes. Nitrous oxide is contributed about 45% by man influenced sources mainly through fossil fuel consumption, nitrogenous fertilizers, burning rain forest and animal wastes. Atmospheric concentration is quite low at around 0.31 ppmv, and they are rising much more slowly than methane.

Chlorofluorocarbons are extremely effective greenhouse gases. Although there are lower concentrations of CFCs in the atmosphere than CO_2, they trap more heat. A CFCs molecule is 10,000 times more effective in trapping heat than a CO_2 molecule. CFCs molecule survives for 110 years because it is very stable and decay slowly. CFCs rise and gradually accumulate in the stratosphere where they are broken down by the sun's ultraviolet light, so releasing chlorine atoms. Chlorine attacks the ozone (O_3); one chlorine atom can help to destroy 100,000 ozone molecules. So it is necessary to achieve the global phase-out of CFCs at the earliest. It is this that causes people to want to ban them completely. CFCs have been identified as the cause of the destruction to the ozone layer, which is also a greenhouse gas. They are found in refrigerators, air conditioners, asthma inhalers, packaging and propellants in aerosol spray.

Although SO_2 is a greenhouse gas its accumulation in the atmosphere has probably had a net cooling effect. SO_2 released in the gas phase is

converted to aerosol particles of sulphate. These aerosol particles absorb short-waves radiation. These particles are the main condensation nuclei for water vapour, which ultimately become the source of clouds. Sulphate aerosols last for short periods in the troposphere but its life time in the stratosphere is several years. The source of sulphate in stratosphere is volcanic eruption, e.g. the eruption of Elchino (1982) and Pinatubo (1991) produced a cooling effect for several years because of the presence of sulphate aerosol in stratosphere. Dimethylsulphid (DMS) is produced in large amounts by some marine phytoplankton, and could act in a feedback loop to stabilize temperature. High sea temperature could lead to more DMS being produced: this increases cloud cover, reflecting solar radiation and trapping heat radiated from the earth.

IV. Effects and Complications

Because of the combined effect of greenhouse gases, the changes that are happening now are certainly rapid enough. If no action is taken the green house effect could lead to rise in average global temperatures between 1.5°C to 4.5°C as early as the year 2030. The experts from the Inter Governmental Panel on Climate Change (IPCC) confirmed that the 1990s have been the hottest decade since records began 150 years earlier. According to them eleven of the twelve years in the period (1995-2006) rank among the top 12 warmest years in the instrumental record. They also found that the average temperatures had risen by roughly 0.74°C since 1900. And forecasts for the future are even more alarming as said earlier. These rises will be greater towards the poles and less at the tropics. There will also be more warming in winter than summer. Such increases will make the world hotter than it has been for more than 100,000 years. The rise will also be faster than ever before. Overall effects are more horrifying. Storms, cyclones, gales, hurricanes and typhoon will become more frequent and stronger as oceans heat up causing more water to evaporate. Evidence is building up at an alarming rate from Japan to USA. In September 1991, Japan was hit by typhoon Mireilly, its worst for 30years, then in September 1993 by typhoon Yancy, the worst for 50 years. In March 1993, 'the storm of the century' hit North America and in the recent past (1998 to 2009) there were many storms and hurricanes in that region particularly and the rest of the world in general. In the same way the continental heartlands will face draughts, Ethiopia, suffered one of the worst heat wave and draught in recent past. As far as floods are concerned, it is noteworthy that sea levels are rising at a rate of 1 to 2mm each year due to the melting of the polar ice and mountain glaciers. It is observed that the rise in sea level during 1993-2003 was at an average rate of 3.1mm/year. If it is not checked, the predicted rise by 2050 is between 20cm-50cm. This will be the major cause of flooding in the coastal areas, estuaries and low laying islands such as Bangladesh, Nile delta, Maldives.

Although the contribution made by fossils fuel (Oil, Gas and Coal) to our modern lives is incalculable. Even today, when alternative sources of energy have been developed, fossil fuels continue to meet almost all our power needs. Still fossil fuels are ahead of the competition. Unfortunately, as our economies continue to grow, we are using more fossil fuels than ever before. Almost four-fifths of the worlds energy comes from them. And forecasts suggest their dominance would not end any time soon, either.

On current trends, the world`s use of energy is set to almost double in the first 30 years of this century, with about 90% of the growth likely to be met by gas, oil and coal. Oil is more in demand than ever, and supplies are expected to jump by double. Both oil and coal will maintain their current shares of the total energy, while natural gas is actually expected to rise than ever before. Meanwhile, some alternative sources of energy are expected to go on the back burner that is the nuclear power (less than 7%), while hydro-electricity will hold the modest 2.2% shares. Sources such as solar energy and wind power have been growing with a good pace. No doubt, global standards of living have been improved many fold due to fossil fuels but these carry a critical flaw. The problem relates to how fossil fuels influence the greenhouse effect. Since the industrial revolution began, our use of fossils fuels have been releasing carbon dioxide and other greenhouse gasses into the atmosphere in large amount. Natural disasters such as volcanic eruption also spew heat trapping gasses but it is periodical and comparatively very low in amounts. Our use of fossil fuels is responsible for 85% of the carbon dioxide that has been added to our atmosphere. In the name of progress, we have dramatically enhanced the atmosphere heat trapping ability.

V. Conclusion

It is clear that things are starting to heat up for most of us, and that the number of draughts, storms, floods, heat waves, and other extreme events are on the rise, too. So it is important to slow the warming as much as possible. This means using less fossil fuels, eliminating CFCs altogether, and slowing down deforestation. This can be achieved best through energy conservation, including better use of public transport and through renewable energy such as solar, wave and wind energy. Instead of deforestation we have to start aforestation to soak up carbon dioxide. So we can make a difference by taking positive actions for controlling future greenhouse gas emissions and keep the problem under wraps. While the problem is global, the solution can be resolved regionally or locally. For this we must play our part positively and sincerely and become a part of the solution rather than the problem.